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(54) Electric heater assembly for cooking range

(57) An electric heater assembly for a glass-ceramic top cooking appliance includes a first heating zone (6) provided with at least one first heating element (8), a second heating zone (7) provided with at least one second heating element (9) and control means (13, 14; 24, 25, 26; 27) for energising the heating elements. The second heating zone at least partially surrounds the first heating zone. The control means is adapted to energise separately the at least one first and the at least one second heating elements (8, 9) from a power supply (15) such that the ratio of actual power dissipated to rated power for the at least one first heating element (8) is substantially the same as, or different from, the ratio of actual power dissipated to rated power for the at least one second heating element (9). Thus, at least in a full power setting of the assembly a specific surface power loading is generated over the first heating zone (6) which is greater than, or substantially the same as, a corresponding specific surface power loading generated over the second heating zone (7), whereas in at least one lower power setting of the assembly a further specific surface power loading is generated over the first heating zone (6) which is substantially the same as, or lower than, a corresponding further specific surface power loading generated over the second heating zone (7).

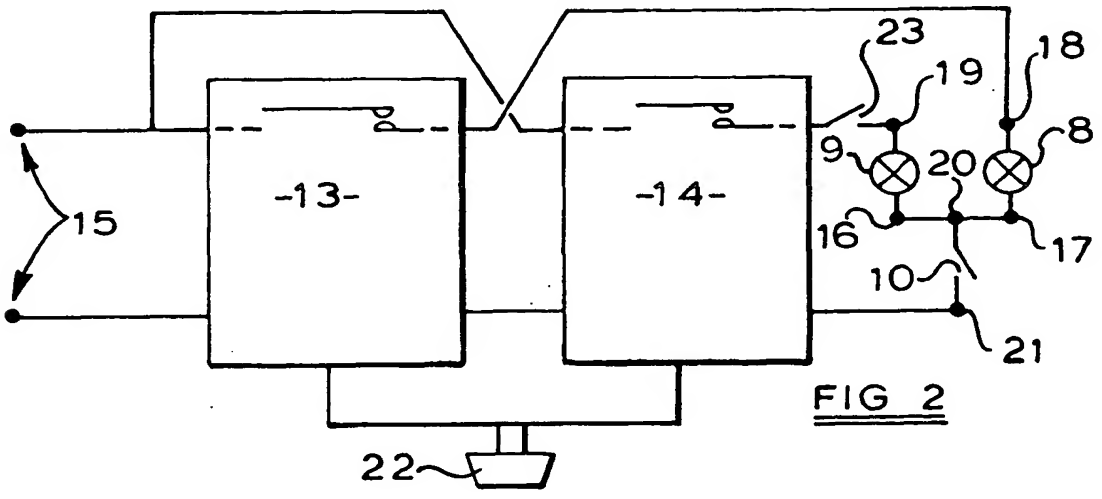

FIG 2

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Description

This invention relates to electric heater assemblies for glass-ceramic top cooking appliances. More particularly the invention relates to such heater assemblies having heating elements arranged and connected in separate circuits such that separate heating zones are provided, namely a first zone at least partially surrounded by a second zone. A wall of insulating material is commonly provided in the heater assembly, separating the two zones.

Heater assemblies of this kind are known in which the heating elements are, for example, of wire coil, ribbon or lamp form, or combinations thereof.

With any heater assembly for glass-ceramic cooking appliances an important parameter is the glass-ceramic surface power loading over the or each heating zone of the heater assembly, that is the actual power dissipated within each heating zone divided by the surface area of the glass-ceramic overlying the or each heating zone. The power loading on the glass-ceramic is typically between 5.0 and 8.5 watts per square centimetre.

With a dual circuit heater assembly, in which two concentric heating zones are provided, it is generally arranged for the total power of the heater assembly, that is with the elements in both zones energised, to be substantially the same as that of a single circuit, single heating zone, heater assembly of the same size. For example a heater assembly of 210 mm heated diameter may have a total power of 2200 watts. In the case of a single circuit heater assembly providing a single heating zone, the surface power loading over the heating zone is about 6.4 watts per square centimetre for a power of 2200 watts.

In the case of the dual circuit heater assembly with two heating zones, the inner zone having a heated diameter of 145 mm, the total power of, for example 2200 watts, has to be split between the heating elements in the two zones. A compromise has tended to be adopted, with a typical split of power being 1000 watts in the inner zone and 1200 watts in the outer zone. This results in a surface power loading of about 6.1 watts per square centimetre in the inner zone and about 7.3 watts per square centimetre in the outer zone. The greater power loading in the outer zone reflects the importance of an edge-weighted heat distribution, when cooking with both zones in operation, for example for cooking items such as pancakes, for heating delicate sauces and for melting chocolate.

A useful parameter can be defined as the edge weighting ratio, which is the ratio between the power per unit surface area of the outer heating zone and the corresponding power per unit surface area of the inner heating zone. In the example given above, this ratio is approximately 1.2.

A disadvantage of this compromise is that the heater assembly when operated with only the inner zone energised has a poor performance compared with a single zone heater assembly of the same area as this inner zone, which typically has a power of 1200 watts and provides a surface power loading of about 7.3 watts per square centimetre.

A solution to this problem is described in EP-A-0551172 where a heater assembly is provided having a heating element in the inner heating zone and two heating elements in the outer heating zone. For a 2200 watt heater assembly the power of the element in the inner zone is 1200 watts when only the inner zone is energised. This therefore matches the power of a separate single zone heater assembly of the same area as the inner zone. The heating elements in the outer zone are provided with two circuits arranged such that when both inner and outer zones are in operation one of the heating elements in the outer zone is connected in series with the element in the inner zone to reduce the power dissipated by the element in the inner zone to 1000 watts. At the same time the second heating element in the outer zone is energised, with the combined power of the heating elements in the outer zone being arranged to be 1200 watts. This arrangement provides desirable edge weighting with both zones in operation while providing good performance of the heater assembly when only the inner zone is in operation.

A disadvantage of this solution is the cost of providing the heater assembly with three circuits and extra terminations to accommodate these.

It is an object of the present invention to overcome or minimise this problem.

The present invention provides an electric heater assembly for a glass-ceramic top cooking appliance, the assembly comprising a first heating zone provided with at least one first heating element, a second heating zone provided with at least one second heating element, the second heating zone at least partially surrounding the first heating zone, and control means for energising the at least one first and the at least one second heating elements, wherein the control means is adapted to energise separately the at least one first and the at least one second heating elements from a power supply, such that the ratio of actual power dissipated to rated power for the at least one first heating element is substantially the same as, or different from, the ratio of actual power dissipated to rated power for the at least one second heating element, whereby at least in a full power setting of the assembly a specific surface power loading is generated over the first heating zone which is greater than, or substantially the same as, a corresponding specific surface power loading generated over the second heating zone and whereby in at least one lower power setting of the assembly a further specific surface power loading is generated over the first heating zone which is substantially the same as, or lower than, a corresponding further specific surface power loading generated over the second heating zone.

The control means may comprise a first energy reg-

ulator for energising the at least one first heating element at selected first duty cycles from the power supply and a second energy regulator for energising the at least one second heating element at selected second duty cycles from the power supply, the first and second energy regulators being adapted to be cooperable in tandem by a manual operating means whereby, for any specific setting of the manual operating means, predetermined first and second duty cycles are arranged to be provided for energising the at least one first and the at least one second heating elements respectively.

The first and second energy regulators may comprise electromechanical devices or electronically-controlled relays.

Alternatively the control means may comprise first and second phase control means for connection to an alternating current power supply and to the at least one first and the at least one second heating elements respectively, the first and second phase control means being adapted to be cooperable by a manual operating means whereby, for any specific setting of the manual operating means, the at least one first and the at least one second heating elements are energised at predetermined first and second phase angles of the power supply.

Alternatively the control means may comprise first and second burst fire control means for connection to an alternating current power supply and to the at least one first and the at least one second heating elements respectively, the first and second burst fire control means being adapted to be cooperable by a manual operating means whereby, for any specific setting of the manual operating means, the at least one first and the at least one second heating elements are energised by predetermined first and second selected whole numbers of half cycles out of a predetermined sequence of the same or a larger whole number of half cycles of the alternating current power supply.

The at least one first and the at least one second heating elements may be selected from any of the well known forms, such as coiled wire, ribbon, or lamp, forms, or combinations thereof.

In particular, the at least one first and the at least one second heating elements may comprise lamps, particularly halogen lamps, optionally connectable in series with ballast resistance means for damping inrush current.

The specific surface power loading over at least one, and optionally both, of the first and second heating zones in the at least one lower power setting may be less than in the full power setting.

The invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is a plan view of one embodiment of a radiant heater for use in a heater assembly of the invention;

Figure 2 is a schematic representation of one embodiment of heater assembly according to the invention;

Figure 3 is a schematic representation of another embodiment of heater assembly according to the invention; and

Figure 4 is a schematic representation of a further embodiment of heater assembly according to the invention.

Referring to Figure 1, a radiant electric heater 1 is provided for location beneath a glass-ceramic cook top (not shown) in a cooking appliance. The heater has a container in the form of a metal dish 2, containing a layer 3 of microporous thermal and electrical insulating material. A ring-shaped wall 4 of insulating material extends peripherally around the heater, inside the dish 2, on top of the insulating layer 3.

A ring-shaped inner wall 5 of insulating material is provided on top of the insulating layer 3. When the heater is installed in a glass-ceramic top cooking appliance, at least the peripheral wall 4, and optionally also the inner wall 5, is pressed against the underside of the glass-ceramic cooking surface.

Two concentric heating zones are provided in the heater, an inner zone 6 being surrounded by an outer zone 7. In the inner zone 6, a heat source is provided in the form of a generally circular halogen lamp heating element 8, of well-known form and construction.

In the outer zone 7 of the heater a further heat source is provided in the form of a generally circular halogen lamp heating element 9, of well known form and construction.

A well known form of temperature sensitive limiter 10 is provided, with its probe 11 extending across the heater above the lamps 8, 9.

To restrain the lamps 8, 9 against movement relative to the insulating layer 3, spacing and securing means 12 are optionally provided, such as are described, for example, in EP-A-0343868.

The lamp heat source 8 in the inner heating zone 6 and the lamp heat source 9 in the outer heating zone 7 are arranged in separate circuits for energisation from a power supply (not shown in Figure 1).

By way of example, in the case of a heater of about 210 mm heated diameter, a surface area of the glass-ceramic of about 165 square centimetres is heated by the inner heating zone 6, while the total surface area of the glass-ceramic heated by the inner heating zone 6 and the outer heating zone 7 together is about 346 square centimetres. If the heater is operated from a power supply of about 230 volts and the lamp heat source 8 in the inner zone 6 has a full or rated power of 1200 watts, while the lamp heat source 9 in the outer zone 7 has a full or rated power of 1000 watts, then the surface power loading for the inner zone 6 will be about

7.3 watts per square centimetre, whereas the surface power loading for the outer zone 7 will be about 6.3 watts per square centimetre. This results in good cooking performance if the heater is operated at full or rated power with either only the inner zone energised for a small cooking utensil, or both zones energised, and the function is to rapidly heat, for example, a quantity of water or oil.

This situation, where the surface power loading for the inner zone is greater than that for the outer zone is described as centre weighting of the heater power. This is the opposite of what is described as edge weighting, where the surface power loading for the outer zone is greater than that for the inner zone. The expression 'edge weighting ratio' is used for convenience and represents the ratio between the surface power loading for the outer heating zone and that for the inner heating zone. In the above example, the edge weighting ratio is 6.3 divided by 7.3, namely 0.86. Such a figure of less than unity corresponds to a heater with centre weighting of power, while a figure of greater than unity corresponds to a heater with edge weighting of power.

The assembly of the present invention enables the heater to be operated in a full power setting with both lamp heat sources 8 and 9 energised at their full or rated power, such that the heater is centre weighted powerwise. It would also be possible to arrange a full power setting with lamp heat source 9 energised at its full or rated power, but lamp heat source 8 energised at less than its full or rated power, but without resulting in edge weighting. However in at least one lower power setting of the heater, with both lamp heat sources 8 and 9 in operation, the heater power is arranged to be edge weighted, although it can also be arranged to be neither edge weighted nor centre weighted.

This is achieved by a control means which provides separate energising of the two lamp heat sources 8 and 9 from the power supply, such that the ratio of actual power dissipated to full or rated power for the lamp heat source 8 in the inner heating zone 6 is able to be made substantially the same as, or different from, the ratio of actual power dissipated to full or rated power for the lamp heat source 9 in the outer heating zone 7.

One example of a control means is illustrated in Figure 2. Two electromechanical cyclic energy regulators 13, 14 are provided, connected to a power supply 15. One of the regulators 13 is connected to the lamp heat source 8 in the inner heating zone of the heater 1 of Figure 1, through the temperature limiter 10 and the other of the regulators 14 is connected separately to the lamp heat source 9 in the outer heating zone of the heater 1 of Figure 1, through the temperature limiter 10. The electrical connections to the heater 1 are represented by reference numerals 16 to 21.

The energy regulators 13, 14 are each of well known form. However they are arranged to be mechanically cooperable in tandem by a manual operating means 22. Energy regulator 13 is arranged to energise the lamp heat source 8 at selected first duty cycles from the power supply 15 and energy regulator 14 is arranged to energise the lamp heat source 9 at selected second duty cycles from the power supply 15. The energy regulators 13, 14 are cooperable in tandem by the manual operating means 22 in such a way that, for any specific setting of the manual operating means by a user of the assembly, predetermined first and second duty cycles are arranged to be provided by the regulators 13 and 14 respectively for energising the lamp heat sources 8 and 9 respectively. The ratio of actual power dissipated to rated power for the lamp heat source 8 can be arranged to be substantially the same as, or different from, the ratio of actual power dissipated to rated power for the lamp heat source 9. In the full power setting of the assembly, a specific surface power loading is generated over the inner heating zone 6 of the heater, in which the lamp heat source 8 is provided, which is greater than a corresponding specific surface power loading generated over the outer heating zone 7 of the heater, in which the lamp heat source 9 is provided. In the case of the exemplified heater, the surface power loading for the inner zone 6 will be about 7.3 watts per square centimetre whereas that for the outer zone 7 will be about 6.3 watts per square centimetre. As discussed earlier, this heater has centre weighting of power in this condition, the edge weighting ratio being 0.86.

In this full power setting, rapid heating of, for example, water or oil in a cooking vessel overlying the heater can be achieved.

In lower power settings of the manual operating means 22 the operation in tandem of the two energy regulators 13, 14 can be predetermined to provide desired ratios of actual power dissipated to rated power for each of the lamp heat sources 8 and 9. Consequently according to a chosen setting, the specific surface power loading generated over the inner heating zone 6 by the lamp heat source 8 can be arranged by design to be made higher than, the same as, or lower than the corresponding specific surface power loading generated over the outer heating zone 7 by the lamp heat source 9.

In this way, the heater assembly can be arranged to provide a heater which is centre weighted in power in a full power setting and able to be edge weighted in power in one or more lower power settings (for example with an edge weighting ratio of 1.2), or neither edge weighted nor centre weighted (edge weighting ratio of 1.0) in one or more lower power settings. An edge weighting ratio of greater than 1.0 is particularly desirable in the cooking of delicate commodities such as pancakes and sauces.

The heater 1 may be operated for a small cooking utensil with only the inner zone 6 energised, namely with only the lamp heat source 8 in operation. This is achieved by opening a switch 23. The lamp heat source 8 is then controlled by the energy regulator 13, by way of the manual operating means 22. In its full power setting, this inner zone 6 provides good cooking performance equivalent to a typical single zone heater of the

same size, on account of the high surface power loading which, in the example is about 7.3 watts per square centimetre.

Instead of using electromechanical energy regulators 13, 14 for the control means, cooperable electronically controlled relays could be used to separately energise the lamp heat sources 8 and 9. Such an arrangement is shown in Figure 3. An electronic controller 24, operated by manual operating means 22A is programmed to control relays 25 and 26 which are connected separately to the lamp heat sources 8 and 9 in the heater 1 (Figure 1). Electronically controlled relay 25 is arranged to energise the lamp heat source 8 at selected duty cycles from the power supply 15 and electronically controlled relay 26 is arranged to separately energise the lamp heat source 9 at selected duty cycles. The electronically controlled relays 25 and 26 are effectively controlled in tandem by operation of the manual operating means 22A and function in the same way as previously described for the electromechanical energy regulators 13 and 14 in Figure 2 for controlling the lamp heat sources 8 and 9 in the heater 1, to provide required surface power load distributions between the inner and outer heating zones 6, 7 of the heater according to the setting of the manual operating means 22A.

Figure 4 illustrates alternative control means for the heater assembly of the invention. An electronic controller 27 is arranged to incorporate first and second phase control means connected to an alternating current power supply 15, one phase control means being connected to lamp heat source 8 in the heater from the power supply 15, by way of leads 28 and 29, and the other phase control means being connected to lamp heat source 9 in the heater, from the power supply 15, by way of leads 30 and 29. The two phase control means in the controller 27 are arranged to be cooperable in predetermined manner in association with a manual operating means 22B, whereby for any specific setting of the manual operating means 22B by a user, the lamp heat sources 8 and 9 are separately energised at predetermined phase angles of the alternating current power supply 15. The control effect on the heater 1 is substantially the same as that previously described with reference to the cyclic energy regulators of Figures 2 and 3. By means of the two cooperable phase control means in the controller 27, the ratio of actual power dissipated to rated power for the lamp heat source 8 in the inner heating zone 6 is arranged to be the same as, or different from, the ratio of actual power dissipated to rated power for the lamp heat source 9 in the outer heating zone 7. At least in a full power setting of the assembly by means of the manual operating means 22B, a specific power loading is generated over the inner heating zone 6 of the heater 1 (Figure 1) which is greater than (or could be substantially the same as) a corresponding specific surface power loading generated over the outer heating zone 7. In lower power settings of the assembly, by means of the manual operating means 22B, further specific surface power loadings are generated over the inner heating zone 6 which are either the same as, or lower than, corresponding further specific surface power loadings generated over the outer heating zone 7 of the heater 1.

Instead of the electronic controller 27 in Figure 4 incorporating first and second phase control means connected to the alternating current power supply 15, the controller 27 could incorporate first and second burst fire control means connected to the alternating current power supply 15 and to the lamp heat sources 8 and 9. One burst fire control means is connected to lamp heat source 8 in the heater by way of leads 28 and 29, and the other burst fire control means is connected to lamp heat source 9 by way of leads 30 and 29.

The two burst fire control means in the controller 27 are arranged to be cooperable in predetermined manner in association with manual operating means 22B whereby for any specific setting of the manual operating means 22B the lamp heat sources 8 and 9 are separately energised by the two burst fire controllers and each by a predetermined selected whole number of half cycles out of a predetermined sequence of the same, or a larger, whole number of half cycles of the alternating current power supply. Thus according to the setting of the manual operating means 22B, the specific surface power loading generated over the inner heating zone 6 by the lamp heat source 8 can be arranged by design to be made higher than, the same as, or lower than, the corresponding specific surface power loading generated over the outer heating zone 7 by the lamp heat source 9.

As is very well known to the skilled person, heating elements in the form of halogen lamps exhibit a high inrush current when initially energised. Such inrush current is well known to be damped by connecting ballast resistance means in series with such lamps, the ballast resistance means generally comprising one or more coiled wire or ribbon form electrical resistance heating elements incorporated in a heater. Consequently, a well known ballast resistance means could be incorporated in the heater of Figure 1 for temporary or permanent connection in series with the lamp heat sources 8 and 9, such ballast resistance means being omitted for simplicity.

Although the heater of Figure 1 incorporates heating elements in the form of lamps 8 and 9, the invention is by no means limited to such heating elements and other well known forms such as coiled wire, or ribbon, could be equally considered. Combinations of heating element types could also be provided and more than one element could be provided in each heating zone.

Furthermore, although the heating assembly of the invention has been specifically described by way of example with reference to a heater having concentric heating zones 6 and 7, any other arrangement where one heating zone at least partially surrounds another is within the scope of the invention. For example one heating zone could be arranged eccentrically inside another or two heating zones could be provided in adjoining side-

by-side relationship, such arrangements in heaters being well known to the skilled person.

Claims

1. An electric heater assembly for a glass-ceramic top cooking appliance, the assembly comprising a first heating zone (6) provided with at least one first heating element (8), a second heating zone (7) provided with at least one second heating element (9), the second heating zone at least partially surrounding the first heating zone, and control means (13, 14; 24, 25, 26; 27) for energising the at least one first and the at least one second heating elements (8, 9), characterised in that the control means is adapted to energise separately the at least one first and the at least one second heating elements (8, 9) from a power supply (15), such that the ratio of actual power dissipated to rated power for the at least one first heating element (8) is substantially the same as, or different from, the ratio of actual power dissipated to rated power for the at least one second heating element (9), whereby at least in a full power setting of the assembly a specific surface power loading is generated over the first heating zone (6) which is greater than, or substantially the same as, a corresponding specific surface power loading generated over the second heating zone (7) and whereby in at least one lower power setting of the assembly a further specific surface power loading is generated over the first heating zone (6) which is substantially the same as, or lower than, a corresponding further specific surface power loading generated over the second heating zone (7).

2. An electric heater assembly according to claim 1, characterised in that the control means comprises a first energy regulator (13, 25) for energising the at least one first heating element (8) at selected first duty cycles from the power supply (15) and a second energy regulator (14, 26) for energising the at least one second heating element (9) at selected second duty cycles from the power supply, the first and second energy regulators (13, 14; 25, 26) being adapted to be cooperable in tandem by a manual operating means (22, 22A) whereby, for any specific setting of the manual operating means, predetermined first and second duty cycles are arranged to be provided for energising the at least one first (8) and the at least one second (9) heating elements respectively.

3. An electric heater assembly according to claim 2, characterised in that the first and second energy regulators comprise electromechanical devices (13, 14) or electronically controlled relays (25, 26).

4. An electric heater assembly according to claim 1, characterised in that the control means comprises first and second phase control means (27) for connection to an alternating current power supply (15) and to the at least one first (8) and the at least one second (9) heating elements respectively, the first and second phase control means (27) being adapted to be cooperable by a manual operating means (22B) whereby, for any specific setting of the manual operating means, the at least one first and the at least one second heating elements are energised at predetermined first and second phase angles of the power supply (15).

5. An electric heater assembly according to claim 1, characterised in that the control means (27) comprises cooperable first and second burst fire control means for connection to an alternating current power supply (15) and to the at least one first (8) and the at least one second (9) heating elements respectively, the first and second burst fire control means being adapted to be cooperable by a manual operating means (22B) whereby, for any specific setting of the manual operating means, the at least one first and the at least one second heating elements are energised by predetermined first and second selected whole numbers of half cycles out of a predetermined sequence of the same or a larger whole number of half cycles of the alternating current power supply (15).

6. An electric heater assembly according to any one of the preceding claims, characterised in that the at least one first (8) and the at least one second (9) heating elements are selected from coiled wire, ribbon, or lamp, forms, or combinations thereof.

7. An electric heater assembly according to claim 6, characterised in that the at least one first (8) and the at least one second (9) heating elements comprise lamps.

8. An electric heater assembly according to claim 7, characterised in that the lamps comprise halogen lamps.

9. An electric heater assembly according to claim 7 or 8, characterised in that the lamps are connectable in series with ballast resistance means for damping inrush current.

10. An electric heater assembly according to any one of the preceding claims, characterised in that the specific surface power loading over at least one of the first and second heating zones in the at least one lower power setting is less than in the full power setting.

11. An electric heater assembly according to claim 10, characterised in that the specific surface power loading over both of the first and second heating zones in the at least one lower power setting is less than in the full power setting.

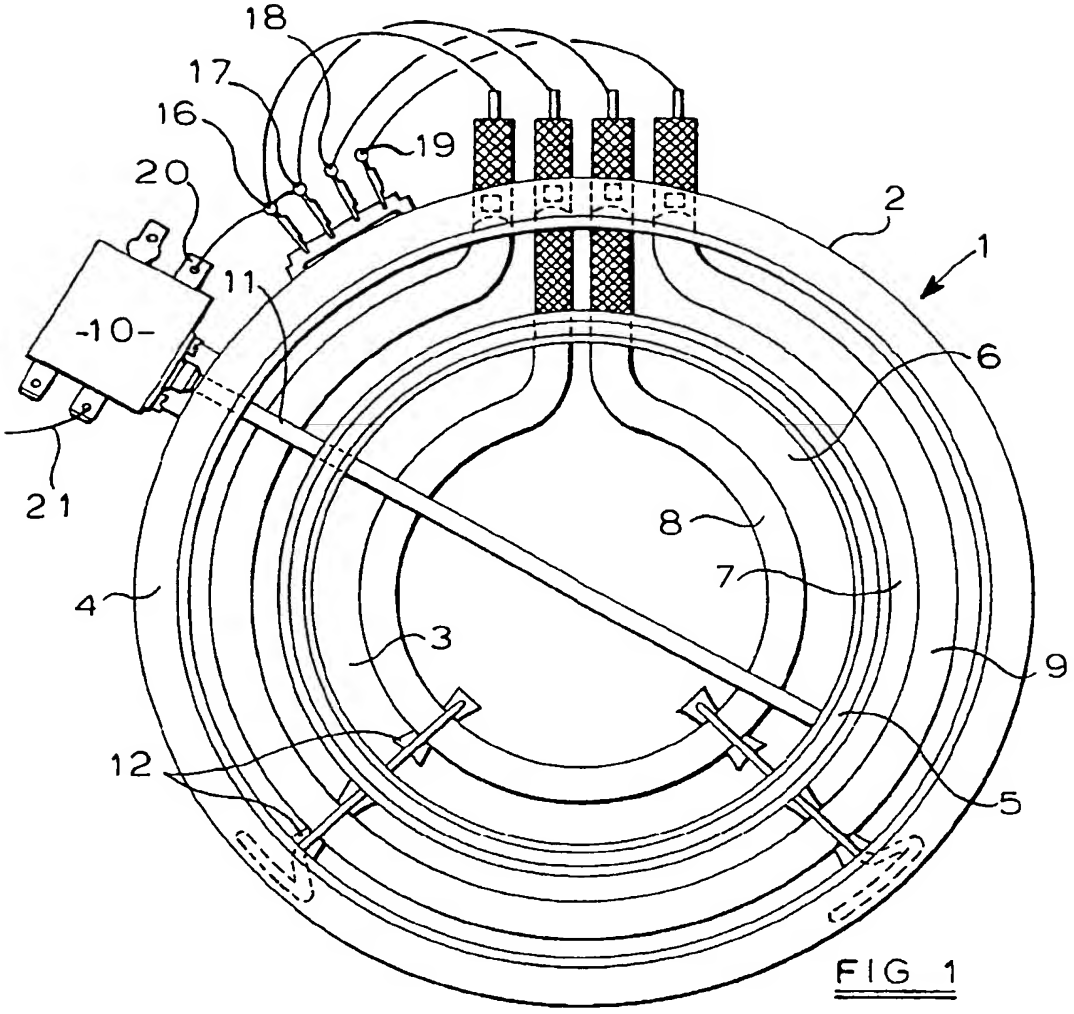
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FIG 1

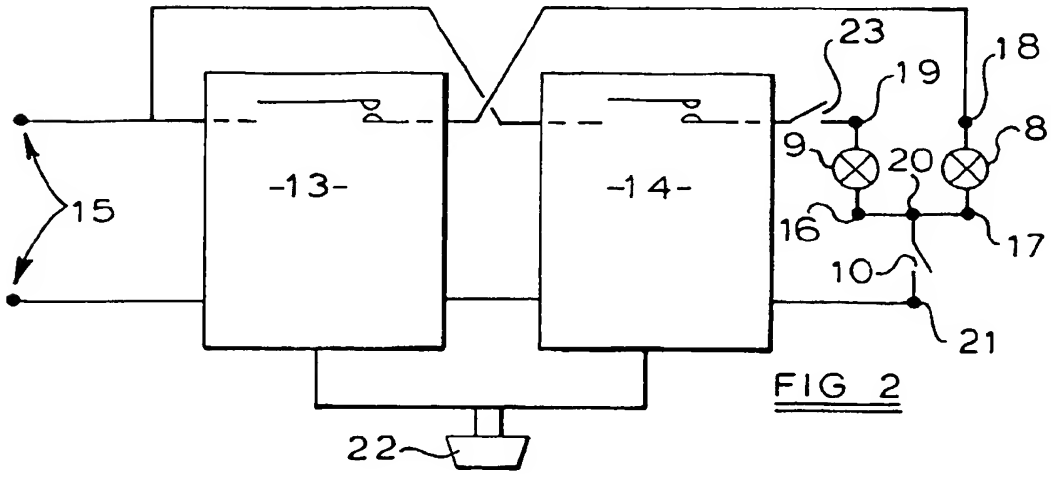
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FIG 2

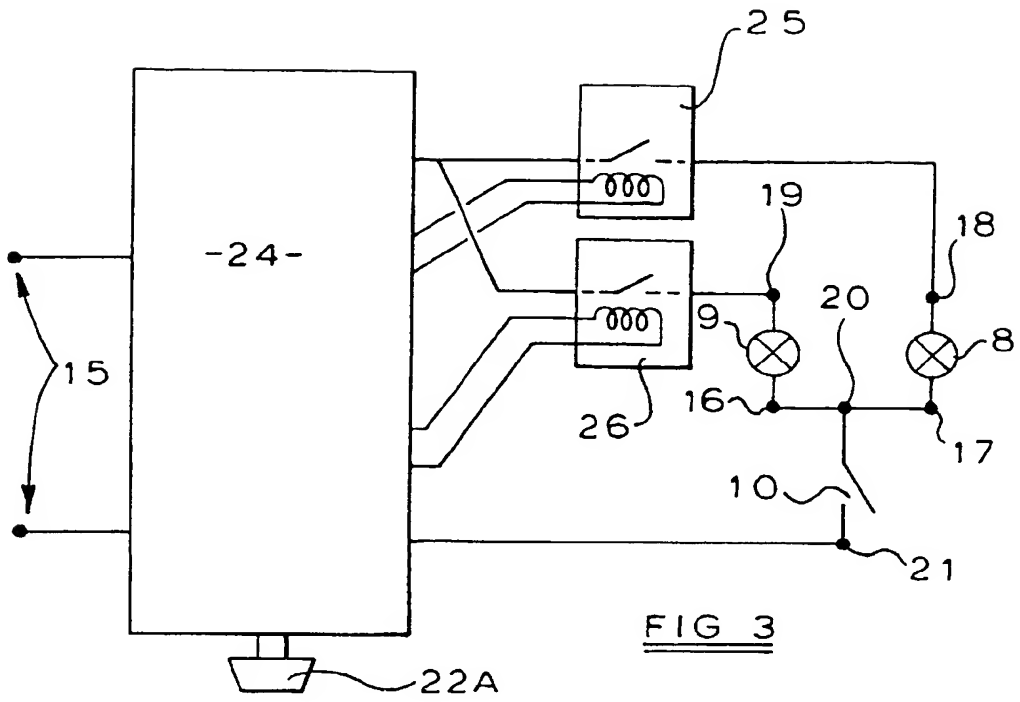

FIG 3

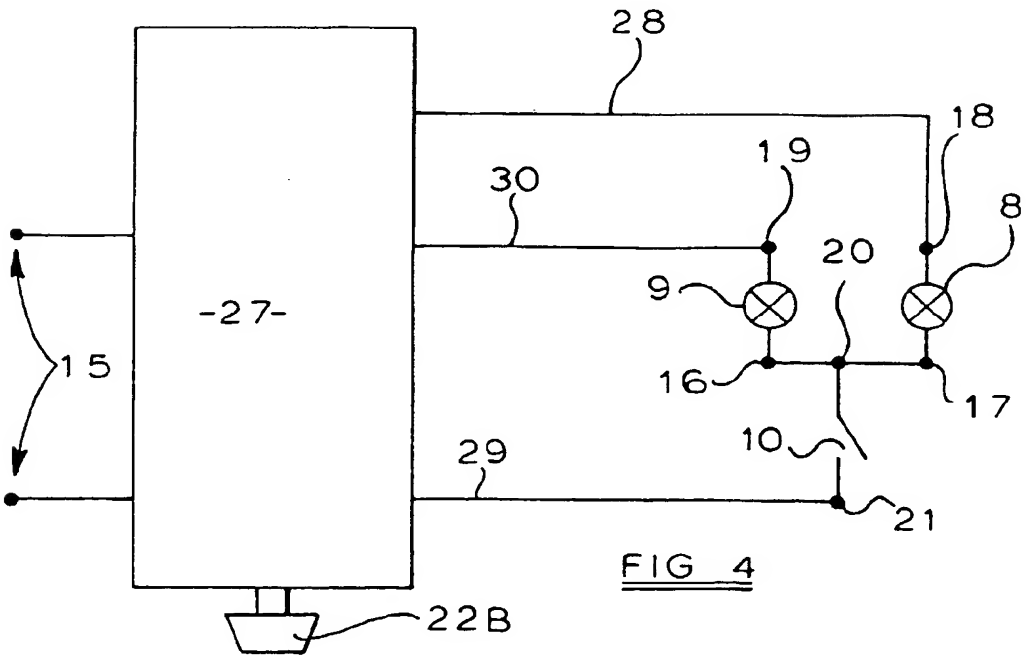

FIG 4

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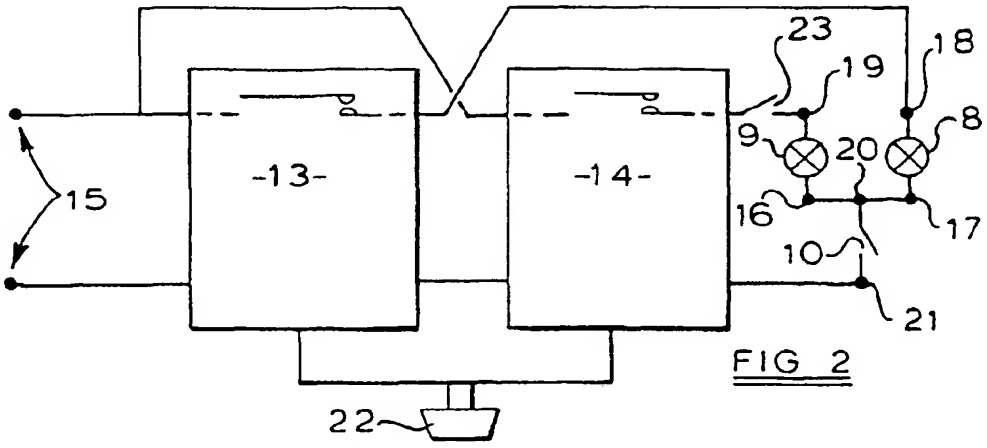

FIG 2

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 5312

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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